ception and the after-estimate. If the claim of the former could not be repressed, our field of vision would really be spherical; as it is, the *fiction* of such a form is harmless, provided it be not mistaken for reality. The probability of completely setting aside the evidence of perception decreases when the contrast between it and the correction urged by experience is too broad, or when the motives for such correction are not forcible enough. In the latter case, the convergence-sensations are not definite, or are not closely connected with the consciousness of size and distance. The influence of these conditions suffices to explain certain optical illusions without bringing in the eye-movement theory. To our indirect vision, a slanting line seems vertical, because our indefinite consciousness of its position does not force us to correct the perception, i. e., to lengthen in thought the distance of its farther end. The apparent curvature of straight lines is easily understood when we remember that straightness is not given in perception, but is a subjective product, and that the distance-relations out of which it grows are liable to vary with the changing effect of convergence-sensations. When these sensations correspond to the main point of regard, the curvature is less marked, because they indicate with special clearness the position and distance of the points in the line. When they have been trained by experience, as in the case of short distances, they yield an immediate impression of true distance and real magnitude; but when such experience is lacking, as it must be for greater distances and very acute angles, their worth, as distance signs, is merely analogical.

If we fixate the middle-point of a straight line, without regard to any point outside, the contradiction between perception and reality is less striking; the naturally favored straightness asserts itself; there is scarce an appearance of curvature. The illusion is more striking when we view the line with reference to a point outside, because the contradiction is greater. Observation of lines that seem to bear towards the eye, concavely or convexly, shows that the chief point of regard and our "spatial middle-point" *may* coincide, but not that they necessarily do so. Our consciousness of curvature is therefore variable, and is conditioned, not by the laws of eye-movement, but by our own mode of apprehension. The same holds good of our space-estimate and its results. The ground seems to rise towards the horizon, not because we raise our eyes, but because we underrate the distance of remotest points. The right eye undermeasures a line on the left, and vice-versa, because owing to the acuteness of the angle, we undervalue the distance differences between the line and the remoter eye. In binocular vision, the nearer eye guides our estimate according to the principle of "habitual average valuation," and the judgment thus formed affects monocular vision. The same principle accounts for errors in measuring vertical distances, and for the over-estimate of horizontal distances on the left as compared with those on the right.

E. PACE.

DE MEMME, *L'ipotesi degli spazi a* n *dimensioni in rapporto con la psicologia e la gnoseologia*, Riv. di filos. scient. 1891 (2) X. 688.

On the principle that geometry of *n* dimensions is merely algebra written in metaphor, De Memme criticises the hypothesis of Helmholtz and its application, by De Saussure, to physical and chemical problems.

FALK, *Versuche über die Raumschätzung mit Hülfe von Armkenegungen.* Inaug. Diss., Dorpat, 1890, p. 58.

Falk studied the absolute and relative error in judging space distances by a movement of the forearm. The forearm was supported from elbow to finger-tip in a convenient carriage moving along a slide; this carriage

could be stopped at either end at desired points so that the distance moved over could be conveniently and accurately read off. By aid of certain appliances the apparatus was serviceable for the methods of right and wrong cases and of the average error. There was also used a combination of the method of right and wrong cases, and of the just observable difference, which has nothing in its favor and its complexity against it. At other points the author is too much dominated by methods hardly applicable to the variable character of his results. The movements varied from 1 to 20 cm., and were made with the shoulder joint as a pivot, moving through an angle of from about 2° to 40°. Falk studied the effect of the rate of movement and the weighting of the carriage upon the constant and the variable errors. The attempt to reproduce distances of 1 cm. resulted in an exaggeration of 81% of 25 cm., 33% of 5 cm., 12.4% of 10 cm., an underestimation of 0.45%; and of 20 cm., 0.82%. The movements forward or away from the body are somewhat more accurate than movements backward or toward the body. Weighting the carriage with from 100 to 600 grms. does not appreciably affect the constant error. Passing to the variable error the measure of sensibility is not constant; when expressed by $\frac{1}{12}$ for 1 cm., it is $\frac{1}{19}$ for 2.5 cm., $\frac{1}{36}$ for 5 cm., $\frac{1}{47}$ for 10 cm., and $\frac{1}{57}$ for 20 cm.; the smaller movements showing the least sensibility. Movements forward show rather finer sensibility than movements backward. The rate of movement has only a slight effect upon the percentage of right judgments, that of 6 per minute having a slight advantage. The effect of weighting the carriage is also insignificant. Weber's law does not hold within the distances measured. The curve of movement as recorded on a drum and shown to gain slowly, reach a period of constancy and maximum rate, and again fall off.

BONNIER, *Physiologie du nerf de l'espace*, Comptes rend. 1891 CXIII. 566.

An acoustic disturbance coming from a given direction arrives at the ear under a certain angle of incidence, is reflected by the concha and the walls of the meatus externus and reaches the tympanum under a new angle of incidence which for a given end depends on the original angle. The concave and conical tympanum is driven back in the axis of its cone, if the noise arrives in that direction, and oscillates sidewise if the sound arrives in an oblique direction, drawing after it the point of the hammer. The system of the anvil and hammer forms a bent lever suspended on an axis that, thanks to the articulation of the joint, itself bends in the form of an elbow, and can turn in any direction. On both sides of this articulation there are three pivots, two for the hammer and one for the anvil. The external process of the hammer serves as pivot for the lateral downward oscillations of the hammer and as axis for the backward oscillations. The short process serves, above all, as axis for the movements from without inward, and as pivot for oscillations in any direction. The superior posterior process of the anvil serves as its pivot for all movements of bending in the central articulation and as axis for the direct oscillatory movements of the entire system. The articulation permits motion in every direction while yet retaining the total oscillation from without inward. According to the lateral oscillation of the point of the hammer, the system bends so that the surfaces of articulation quit each other at some points to meet at others, in such a manner that the angle formed by the two free arms varies in planes equally variable. The point of the anvil transmits by a double articulation its oscillations to the head of the stirrup, which in its turn oscillates around its tendinous insertion, pushing the base of the fenestra ovalis according to its various inclinations, which are the reverse of those of the point of the anvil, but always without disturbing the backward compression. According to its obliquity the plate of the stirrup